	$\odot$	Martian date	Opposition
1894			
Sept. 8	277°	Jan. 6	Oct. 20, 1894
to			
Nov. 18	320°	Feb. 17	
1896			
July 25	277°	Jan. 6	Dec. 10, 1896
to			
Aug. 23	320°	Feb. 17	
1898			
July 12	295°	Feb. 9	Jan. 18, 1899
to			
Aug. 23	320°	Feb. 17	
1907			
Nov. 12	276·5°	Jan. 6	July 5, 1907
to			
Jan. 25	320°	Feb. 17	

During all these periods the planet was kept under observation at Flagstaff, and during none of them were any such canals recorded. We are, therefore, sure that seasonal change cannot explain them, and that two years ago, and also eleven, thirteen, and fifteen years ago, no such canals existed. In Martian chronology this means that not only did they not exist in their present state during the previous Martian year, but also not four, five, and six Martian years before that. It is also fairly sure that they were not in existence thirty and thirty-two years ago, inasmuch as Schiaparelli never saw them.

Lastly, a further point disclosed by the Flagstaff observations must be reckoned with, a point of very singular significance. It was long ago discovered there that (see Bulletin No. 8 of the Lowell Observatory), while the great majority of the canals are quickened into conspicuousness alternately every six Martian months, first from the south and then from the north polar cap, certain ones respond only to one or the other cap, remaining inert to the action of its antipodal fellow. To be sure, therefore, that the new canals were really new to Mars, the old drawings had to be examined on this score too. Here again the records were decisive. No such canals had ever appeared before from the quickening of either cap at the time when, had they existed then, they should have showed.

The canals in question, therefore, proved to be, not simply new canals to us, but new canals to Mars. In the canal system they are *novae* in fact or function, and as such are the most important contribution to our knowledge of the planet of recent years. For let us see what they imply. In form they are like all the other canals, narrow, regular lines of even width throughout, running with geometric precision from definite points to another point where an oasis is located. This oasis resembles all the other oases, a small, round, dark spot. They partake, therefore, of all the peculiar features of the canal system, features which I have elsewhere shown make it impossible of natural creation, that is, of being the result of any purely physical forces of which we have cognisance. On the other hand, the system exactly resembles what life there would evolve under the conditions we know to exist. The present phenomena, then, show that the canals are still in process of creation, that we have actually seen some formed under our very eyes.

Thus, on every point which had to be considered, the records furnished conclusive evidence that the canals in question could not have existed in past Martian years in the condition in which we observe them to-day. Their previous non-visibility could not have been due to any of the causes which might possibly affect it, to wit:—(1) Want of size; (2) any personal equation of the observer; (3) improved instrumental or atmospheric means; (4) distance (all these are negatived by their striking conspicuousness); (5) phase; (6) regular seasonal change; and last (7) unihemispheric seasonal change.

It will be perceived that the proof that these canals are *novae* has been possible, and only possible, through the long systematic work done on the planet here for the last fifteen years. Without such a complete system of records the certainty that the canals in question were new canals *to Mars* could not have been reached.

PERCIVAL LOWELL.

Lowell Observatory, Flagstaff, A.T.

PROPERTIES OF POLONIUM.

THE statements regarding polonium which appeared in the report from Paris reprinted from the *Times* in NATURE of February 17, must have surprised many readers to whom polonium has been a familiar substance for the last ten years. It may be of interest to review briefly our present knowledge of polonium and the bearing of the recent work of Mme. Curie and Debierne upon it.

Polonium was the first of the active substances separated from pitchblende residues by Mme. Curie. Various methods of concentration were devised by her, with the result that preparations of polonium mixed with bismuth were early obtained many thousand times more active than uranium. Marckwald later separated from 15 tons of pitchblende about 3 milligrams of intensely active material which he called radio-tellurium, since it was separated initially with tellurium as an impurity. By dipping a copper plate into a solution of this substance, he obtained a deposit of weight not more than 1/100 milligram, which was far more active than an equal weight of radium. It was soon recognised that this preparation was identical with polonium, for it gave off the typical α radiation, and had the characteristic rate of decay of that substance. Unfortunately, Marckwald was not aware at the time of separation of the great importance of testing whether lead appeared as a product of transformation of polonium. Before such an experiment could be made, the polonium had to a large extent been transformed.

Polonium is one of the numerous transition elements produced during the transformation of the uranium-radium series. It is half-transformed in about 140 days, emitting α particles during the process. Rutherford showed in 1904 that polonium was in reality a transformation product of radium itself. Radium at first changes into the emanation, and then successively into radium A, B, C, D, E, F, radium F being identical in all respects with the polonium directly separated from a radio-active mineral. When the radium emanation is allowed to decay in a sealed glass tube, the walls of the tube are coated with an invisible deposit of pure radium D, radium E, and radium F, but the amount of the latter to be obtained in this way is far too small to be weighable.

The amount of polonium present in any radio-active mineral can easily be calculated. Since the radium and polonium (radium F) in a mineral are in radio-active equilibrium, the same number of α particles are expelled from each per second. Since polonium is half-transformed in 140 days and radium in 2000 years, the former breaks up 5000 times faster than the latter. The maximum amount of polonium to be obtained from a mineral is in consequence only 1/5000 of the amount of radium. In 1000 kilos. of pitchblende containing 50 per cent. of uranium, there are present 170 milligrams of radium. The weight of polonium is about 1/5000 of this, or about 1/30 milligram. It is thus obvious that to obtain 1/10 of a milligram of pure polonium, several tons of high-grade pitchblende must be worked up. The most natural source of

polonium is radium D (radio-lead), which grows polonium and has a period of half-transformation of about twenty years. Since polonium breaks up about 5000 times faster than radium, its activity, weight for weight, should be about 5000 times greater than that of radium. There is nothing surprising in this, for the radium emanation has an activity about 200,000 times that of radium, while radium A (period three minutes) must have an activity 400 million times that of radium itself. Since the radiation from polonium is entirely in the form of α rays, it is to be expected that the radiation from it would show chemical and physical effects identical with those observed for pure emanation, the only difference being that the products of the latter emit β and γ rays as well.

Apart from the interest of obtaining a weighable quantity of polonium in a pure state, the real importance of the present investigations of Mme. Curie lies in the probable solution of the question of the nature of the substance into which the polonium is transformed. This problem has been much discussed in recent years. Since polonium emits α particles, one of its products of decomposition, as for all the other α-ray products, should be helium. The production of helium from a preparation of polonium has been observed by Rutherford and Boltwood (Manchester Lit. and Phil. Society, November 30, 1909), and also by Mme. Curie and Debierne in their present experiments. Boltwood several years ago suggested that the end product of the radium series was lead, and has collected strong evidence in support of this view by comparing the amount of helium and lead in old radioactive minerals. Since polonium is the last of the active products observed in the radium series, it is to be expected that polonium should be transformed into helium and lead, one atom of polonium producing one atom of helium and one atom of lead. This point of view receives additional weight from consideration of the atomic weight to be expected for the end product of radium. Since in the uranium-radium series, seven α particles, each of which is an atom of helium of atomic weight four, are successively expelled before radium F is reached, the atomic weight of polonium should be $7 \times 4 = 28$ units less than uranium (atomic weight 238·5). This gives an atomic weight of polonium of 210·5, and after the loss of an α particle, a final product of atomic weight 206·5—a value very close to the atomic weight of lead.

It is a matter of very great interest and importance to settle definitely whether polonium changes into lead. The evidence as a whole has long been in favour of that supposition. The outlook is very promising that the experiments of Mme. Curie and Debierne will settle this question conclusively. No doubt, an interval must elapse to allow the polonium to decay before the final examination of the residual substance can be made.

E. RUTHERFORD.

THE DISCOVERY OF A SKELETON OF PALÆOLITHIC MAN.

DR. CAPITAN and M. Peyrony are to be congratulated on another important discovery of the remains of Palæolithic man on September 17, at Ferrassie, in Dordogne, a locality which has been made famous by the investigations of M. Peyrony during the past decade. Here he has discovered and studied five distinct layers, each containing the artifacts and animal remains of as many well-defined epochs. In ascending order these are:—(1) Acheulian, (2) Mousterian, (3) Lower Aurignacian, (4) Middle Aurignacian, and (5) Upper Aurignacian. The skeleton, which is described by Dr. Capitan in *La Nature* for December 25, 1909, was found between the layers 1 and 2, and as these and the three upper layers were absolutely intact, it is certain that the remains belong to the Mousterian epoch. The first bones seen were the ends of a tibia and femur, and before excavating further an invitation was sent to a number of French archæologists to witness the exhumation. With infinite care and precautions, an entire skeleton was revealed. It lay on its back, with the trunk turned slightly to the left; the legs were strongly flexed, the knees being turned to the right; the left arm was extended along the side, with the hand at the hip; the right arm was flexed, the hand being near the shoulder, and the head was turned to the left, the mouth being open.

The skeleton was photographed *in situ*. Around, above, and beneath were a large number of bones which had served as food for and had been broken by the Mousterians, as well as teeth of bisons, deer, goats and reindeer; the artifacts included points, knife-scrapers, disks, hammers, and bone-breakers of quartz of the Lower Mousterian type (that is, worked on one face only).

The long and small bones were carefully removed. The pelvis, thorax and skull were severally covered with tinfoil, and plaster was poured around each, so that when the plaster set they could be removed without injury. Thus protected, they were taken to Paris without further damage or loss. The restoration, mounting, and study of the skeleton are being undertaken by Dr. Capitan. As no anatomical details have as yet been given concerning the find, anthropologists will have to wait with what patience they can muster until the investigations are completed.

The attention of readers of NATURE has been directed at various times to the recent finds of Palæolithic man, but as this is the first whole skeleton which has been obtained of a Mousterian man, the discovery is one of prime importance.

There is no reason to doubt that the body was definitely placed where it was found; probably it was placed in a corner of a large rock shelter, and covered with earth, stones, and perhaps branches. The shelter was occupied later by generations of men of the Aurignacian epoch. Finally the overhanging chalk roof fell, and its débris subsequently became covered by a layer of stones and earth five feet in thickness. Thus protected, it has remained for 20,000 years.

A. C. H.

TROPICAL AGRICULTURE.[1]

THIS work does not claim to be a handbook for the technical man, but to give information of value to students, administrators, and others on tropical crops, and at the same time to present the political and theoretical aspects of the subject.

Part i. (pp. 1–39) deals with the "Preliminaries to Agriculture." Such topics as soil, climate, labour, transport, capital, supply of water, tools, and plant acclimatisation are briefly discussed, frequently by drawing contrasts between the less known conditions of the tropics and the better known conditions of temperate regions.

Part ii. (pp. 40–141), approximately half the volume, is devoted to the "Principal Cultivations of the Tropics." This is, in our opinion, the least satisfactory portion of the book. The principal industries of Ceylon, with which the author is closely acquainted, are well done. The accounts of rice, coffee, tea, cocoanuts, and Para rubber, are admirable, although for a work dealing with the tropics as a whole Ceylon

[1] "Agriculture in the Tropics." An Elementary Treatise. By Dr. J. C Willis. Pp. xviii+222. (Cambridge: University Press, 1909.) Price 7s. 6d. net.